CHAPTER 3

THE UNDERGRADUATE EXPERIENCE IN SCIENCE, MATHEMATICS, AND ENGINEERING

The underrepresentation of women, minorities, and persons with disabilities in most areas of scientific and technical endeavors is an issue of continuing concern to educators, employers, and those organizations responsible for sponsoring research and development activities. Although the number of women graduating with bachelor's degrees from some scientific fields equals or exceeds the number of men, in many fields there are far fewer women than could be expected from their number in the general population or on college and university campuses (see "Indices of Representation" on page 63). Since 1989, the number of underrepresented minorities earning bachelor's degrees in science, mathematics, and engineering (SME) has risen each year. Underrepresented minorities earned over 17 percent of the total number of undergraduate SME degrees awarded in 1995, up from 12 percent in 1989. (See appendix table 3-1.) The continuing differences in the enrollment and graduation rates of different racial/ethnic groups in science, mathematics, and engineering at the undergraduate level need to be better understood.

This chapter examines factors that influence access, achievement, and educational outcomes for women, minorities, and persons with disabilities who attend 2-year and 4-year institutions. This review of undergraduate education looks at changes in enrollment, course-taking patterns, and outcomes over the past few decades at all institutions of higher learning. It examines patterns of courses taken and outcomes (degrees awarded, attrition) by age, race/ethnicity, and major. An examination of these factors provides a greater understanding of the reasons that disparity among groups entering the fields of science, mathematics, and engineering has persisted.

Persistent Disparity in Science, Mathematics, and Engineering

Since 1980, more women than men have enrolled in college, and since 1982, women have earned more undergraduate degrees than have men. In 1995, women constituted 49 percent of the U.S. population ages 18 to 24 and earned 55 percent of all bachelor's degrees awarded, up from 43 percent in 1966. (See appendix tables 3-2 and 3-3.)

Women

Despite impressive gains, the participation of women in the physical sciences, mathematics, and engineering still lags significantly behind that of white men and Asians, as evidenced by the following:

- Women accounted for 35 percent of the bachelor's degrees awarded in the physical and earth sciences, up from 14 percent in 1966.
- Approximately 1 in 6, or 17 percent, of engineering bachelor's degrees were awarded to women in 1995, an increase from less than 1 percent of the total in 1966.
- Women were awarded 35 percent of the bachelor's degrees in mathematics and computer science in 1995, a slight increase over 1966.

Women are, however, as well or more highly represented than men in some science fields. For example, they earned nearly half of the bachelor's degrees awarded in 1995 in the biological/agricultural sciences and social sciences and 73 percent of the degrees in psychology. (See appendix table 3-2.)

Systematic data on minority participation in science, mathematics, and engineering education have been collected only since the late 1970s. (See appendix tables 3-4 and 3-5.) The bulleted data below show disparities persisting over time. Recent studies provide insight into the role that precollege preparation, self-confidence, work and family, availability of role models, peer support, and teaching methods play in maintaining that disparity.

Loss of Confidence as a Cause of Field Switching Among Undergraduate Women in Science, Mathematics, and Engineering Majors

A recent study shows that many young women bring to their experience of science, mathematics, and engineering (SME) disciplines a pattern of socialization that is entirely different from that of young men. Many aspects of SME majors, which have evolved largely to meet the educational needs of young men, force women into conflict with their own socialization experiences. The resolution of these conflicts is sometimes accomplished by leaving the major, sometimes by making personal adjustments to the dominant male social system.

Broadly speaking, men experience a life-long pressure to manifest an intrinsic sense of self-worth, to respond to challenge with displays of self-sufficiency and stoicism, and to show independence from the need for nurturing. By contrast, the socialization of young women (including their formal education) is biased toward the development of an extrinsic sense of identity. From earliest childhood, throughout the years of formal education, girls are encouraged to perform for the approval of others and to attach feelings of confidence and self-worth to signs that others are pleased by what they do. The degree to which any woman depends on others for her sense of achievement varies according to the mixture of cultural influences that constitute her socialization experiences. The tendency to perform for others is not gender-exclusive: depending on the circumstances of their upbringing and education, young men may also exhibit this trait. One important exception was found to be black women, who reflected a pattern of socialization that encouraged an independent self-image, self-reliance, and assertiveness in getting educational needs met. These women were distinctively inner-directed, compared with other women and most black men.

A pattern of performing for others—with negative consequences for persistence—appeared in several aspects of the study data. Many more women than men reported that they had chosen SME majors at the prompting of family or teachers, rather than for reasons of field or career interest.[1] Choices made primarily to please someone else did not withstand the rigors of an SME major and made students vulnerable to the attractions of other fields.

The study found a difference in the approach to education among young men and young women. An example is their different reasons for disliking large introductory classes. Men disliked them because they "have negative effects on grades," encourage "more competition for grades," and "are usually taught by less qualified faculty." Women disliked large classes because "you don't get to know the professor," "it's too impersonal," and "the professor doesn't care if you learn or attend class." These differences in judgments also suggest that women were more likely to enter college expecting to establish individual teacher-learner relationships.

This expectation was also reflected in the definitions of "good" and "bad" teachers offered by male and female students. Women commonly stressed the importance of a teacher's personal behavior toward them and defined the "bad" teacher as "unapproachable," "impersonal," and "intimidating." Good teachers were seen as "approachable," "friendly," and "patient"; they "really care about you, and want you to learn." Men were less concerned with faculty's openness to student contact than with their effectiveness in presenting the material.

Being raised to work for the approval of others explains why many women enter college without a clear view of what they want from their education and also why the openness of faculty to student contact is so central to many women's definition of the good teacher. For these women, engaging the teacher in a personal dialogue is critical both to the ease with which they can learn and to their level of confidence about their academic performance. The reluctance of many faculty to be drawn into pedagogical or advisory relationships with individual students is a major factor in the decision of many able young women to leave SME majors.[2]

The observations of the students in this study may offer a way to explain the recurrent finding of lowered confidence and self-esteem noted in other studies (Hall and Sandler, 1982; Ware and Dill, 1986; Arnold, 1987; Manis et al. 1993; see also reviews of this literature in Kimball, 1989 and Oakes, 1990). A female student whose confidence in her ability to do

[1] The stronger tendency of women to be drawn into SME majors through the influence of others was also found by Strenta et al. (1993).

[2] Manis, Sloat, Thomas, and Davis (1989) also found the "impersonality" of science and mathematics classes to be more problematic for women than for men.

Loss of Confidence as a Cause of Field Switching Among Undergraduate Women in Science, Mathematics, and Engineering Majors *(continued)*

mathematics and science is overdependent on the judgments of others, does not know how to assess the adequacy of her performance. Her self-confidence may be already shaken by her abrupt reduction in status. In high school, she was treated as special; now, she is part of a minority who are often treated with a perceived hostility that she cannot explain. The consequence for some women is confusion, anxiety, and a strong sense of abandonment. In the study one young woman stated

> Some of my girlfriends and I used to take it really hard when we didn't seem to do so well—you know—hiring tutors, and just struggling and crying over grades—getting out old tests and working extra problems, and making flash cards, and just working extra, extra hard. And it was all because, as hard as we tried, we just could not seem to please the professors. We were just looking for some encouragement.... I used to get nauseated before exams. It took me a long time to get over that.... Eventually, I learned not to take it to heart. It's not you they're grading: it's just your work—and not always that. Men just blow it off. (Female white mathematics non-switcher)

Even when their performance is adequate or good, teacher-dependent students (whether women or men) have difficulty in motivating themselves and in knowing that they are "doing okay" without faculty reassurance. Some of the nonswitching seniors described how difficult it had been to forego the high level of interaction and support to which they had been accustomed throughout their earlier school years. Learning to develop an independent sense of their own ability and progress had been vital to their survival.

> One reason I did well in high school is because I cared about what the teachers thought about me. I knew I was doing well when people were pleased with me. I was always looking for that praise just so I knew I was doing okay. It took me a long time to get over that...I used to get very upset because, here, the teacher doesn't know who you are. (Female white engineering switcher)

Depending on teachers for performance evaluation, reassurance about progress, and as the basis for motivation, constitutes a serious handicap for the many women who enter college having learned how to learn in this manner. Persistence initiatives which do not take this into account simply will not be effective. Looking to a teacher for interpretation and validation of their academic performance is a learned dependence which people can change, or outgrow, but not without first experiencing anxiety and frustration which, for some, ends in field switching. To a much higher degree than is the case for young men, preserving the self-confidence which young women bring into college depends on periodic reinforcement by faculty. To be faced with the prospect of four years of relative isolation and perceived male hostility on the one hand, and the abrupt withdrawal of familiar sources of praise, encouragement, and reassurance by faculty on the other, is the most common reason for the loss of self-confidence that makes able women in the sciences and engineering vulnerable to field switching.

— Adapted from Elaine Seymour and Nancy M. Hewitt, *Talking About Leaving: Why Undergraduates Leave the Sciences* (Westview Press, 1997)

Blacks

- In 1995, blacks, 12 percent of the total U.S. population, earned just over 7 percent of all bachelor's degrees and almost 7 percent of all science, mathematics, and engineering bachelor's degrees awarded in 1995, up slightly from 1989.
- Black women have greater representation than black men, earning over 4 percent of all undergraduate degrees and just over 4 percent of all science, mathematics, and engineering undergraduate degrees awarded in 1995.
- Black men earned over 2 percent of all degrees awarded and almost 3 percent of science, mathematics, and engineering degrees.

Hispanics

- Hispanic men and women make up 10 percent of the U.S. population and earned almost 6 percent of all bachelor's degrees awarded in 1995 and over 5 percent of all undergraduate degrees awarded in science, mathematics, and engineering in that year.
- Hispanic women had slightly higher numbers than Hispanic men, earning over 3 percent of all bachelor's degrees and slightly less than 3 percent of science, mathematics, and engineering degrees awarded in 1995.

Asians

- Asian men and women, who constitute 3 percent of the total U.S. population, continue to be well represented in science, mathematics, and engineering earning over 7 percent of all science, mathematics, and engineering bachelor's degrees awarded in 1995.
- White males earned 58 percent of the degrees in engineering; Asian men earn the second highest percentage with almost 16 percent of the bachelor's degrees.
- Asian women earned slightly over 3 percent of all science, mathematics, and engineering degrees in 1995 but slightly over 13 percent of the engineering degrees earned by women.

American Indians

- The total number of bachelor's degrees awarded to American Indians is relatively

American Indians in Higher Education

Data presented elsewhere in this chapter and the appendix (see "Technical Notes to Chapter 3" and appendix A) show American Indians have the lowest rates of enrollment in and graduation from both 2-year and 4-year undergraduate institutions. Interestingly, the index of representation in text table 3-1 shows that the proportion of American Indian females in college is higher than their proportion in the general population. Together, American Indian males and females earn fewer than 1 percent of bachelor's degrees awarded in all fields.

During the 30 years since Dineh College (formerly Navajo Community College), located in the heart of the Navajo Reservation, was founded, the number of tribal colleges has increased to 30 in 12 States. These colleges now enroll approximately 27,000 students. As Boyer notes, the possibility of American Indian participation in higher education is enhanced by the existence of these tribal colleges.

According to the Carnegie Foundation report, "Isolated by distance and culture, many [American Indians] have come to accept that they cannot complete school. College seems to many American Indians an impossible dream. Tribal colleges offer hope in this climate of despair...without sacrificing academic rigor, courses are often tailored to reflect the unique learning styles of American Indian students." (Boyer, 1977, p. 4)

Tribal colleges have become an integral part of the larger system of higher education for American Indians. Succeeding at a tribal college also appears to encourage students to continue their education and leads to increased employment opportunities.

Although no reliable studies have yet been done about graduation rates from tribal colleges, some tribal college presidents estimate that between 25 and 33 percent of students who enroll eventually receive a certificate or degree (Boyer, 1997). A survey of more than 500 graduates of Turtle Mountain College from 1980 to 1990 found that most graduates were either working or going to school. Fewer than 13 percent were unemployed, which "is in sharp contrast to the total rate of unemployment among Indian people." (Boyer, 1997, p. 68)

Research funded by the Alfred P. Sloan Foundation examined the experience of American Indians majoring in math, science, engineering, or business (McAfee, 1977). The phenomenon of stepping into, out of, and back into higher education emerged as a typical mode of college attendance. Strength of cultural identity had a significant impact on persistence and outcome of undergraduate education. McAfee's findings about the relationship between cultural identity and persistence to degree attainment reinforce the importance of tribal colleges for American Indians in higher education. In addition, McAfee's work suggests that the phenomenon of stepping out is a norm that needs to be better understood and accommodated by institutions of higher education.

small, less than one percent. The trend in number of degrees awarded in science, mathematics, and engineering has been increasing for American Indians at a rate similar to the total population.

Patterns of overrepresentation and underrepresentation of the racial/ethnic and gender groups were analyzed in more detail. To measure the extent to which the various groups were overrepresented, at parity, or underrepresented in the college population, an index of representation (IR) was computed. (See "Technical Notes to Chapter 3" for details.)

The IR for total college enrollment indicates that in 1980 white males and females, Asian males and females, and American Indian females had higher proportions among persons enrolled in college than they had among the general population of 18- to 24-year-olds. Asian males and females had the highest index scores. (See figure 3-1, text table 3-1, and appendix tables 3-6, 3-7, 3-8, and 3-9.) In 1980, black males and females, Hispanic males and females, and American Indian males were underrepresented in the college population. Hispanic males and black males had the lowest index scores. The IR score for American Indian females in 1980 indicates that their representation in the college population was higher than their representation in the general population.

Between 1980 and 1990, except for white females, persons from all racial/ethnic and gender categories were less represented in the college population than in the general population. After 1990, the representation scores of both white males and females decreased while those of the other categories increased. Racial/ethnic minorities have improved their representation in higher education. Black females had almost achieved parity by 1994. Their IR score in 1994 was essentially equal to that of white males whose proportional representation in the college population has systematically decreased below parity. On the other hand, Asian males and females, white females, and American Indian females continued through the beginning years of the 1990s to be overrepresented in the college population. The rate of improvement among black males has been slower than that of the other groups that improved. Hispanic males have caught up with black males in their proportional representation in the college population.

Sources of Persistent Disparity

New research is beginning to identify reasons why more women, minorities, and persons with disabilities do not enroll in or receive bachelor's degrees in science, mathematics, and engineering. Astin and Sax (1996) cite the importance of role models, peer groups, curriculum and pedagogy, and faculty attitudes in the process of developing scientific talent in undergraduate women. Seymour and Hewitt (1997) have argued that problems arising from the nature of the undergraduate experience and the culture of the scientific or engineering discipline (for example, attitudes and practices of the faculty) at the undergraduate level have a significant impact on whether women and minorities stay in science, mathematics, and engineering or switch to other majors. Hanson (1997) found that pervasive gender discrimination still exists at all levels of education and that race and class have a significant impact on success in science.

Two-Year Institutions

Community colleges and 2-year colleges have assumed an increasingly important role in postsecondary education. These institutions now meet many needs, serving those who want to complete requirements for a high school diploma, try out college-level coursework before transferring to a 4-year college, or take job-related courses (Adelman 1997).

The changing role of the community college is not revealed by enrollment statistics alone. Over the past three decades, community colleges have consistently accounted for just under one-quarter of all course enrollments (Adelman 1995). Community colleges attract more minority (particularly Hispanic) and low- to moderate-income students, veterans, and those students with lower grade-point averages and SAT scores.

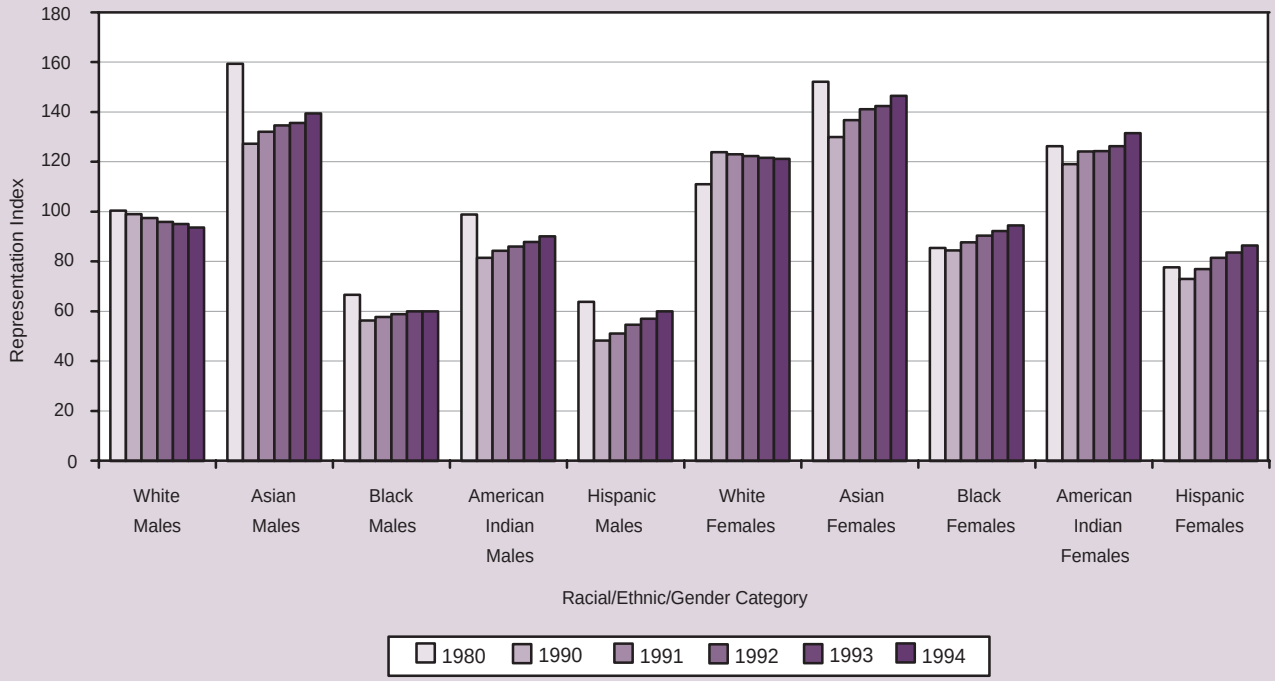
Some interesting differences in course participation patterns between 2-year and 4-year institutions emerged in an analysis conducted by Clifford Adelman of the U.S. Department of Education. According to Adelman, the most traditional way of assessing rates of participation in a field is to ask what proportion of students from a given group takes—and successfully completes—key courses in that field. Where there are considerable differences among groups, what are the reasons for those differences? Some answers may point to factors that cannot be changed, whereas others suggest strategies for better advisement and pre-college education.

Among those students who primarily attend 4-year institutions (see appendix table 3-10), there are several key issues:

- For women, there is no statistically significant difference from men in mathematics course taking until the level of precalculus. In terms of participation rates, women and men are roughly equivalent in college algebra, statistics, and finite/discrete mathematics.
- Women still lean more toward the life sciences than the physical sciences, though their strong participation rates in the two chemistry courses (appendix table 3-10) indicate the border of the physical sciences is accessible.

- The mathematics course-taking patterns of black students have an effect on their participation in other science, mathematics, and engineering fields. Participation rates are high at both the precollege level and at the levels of college algebra and precalculus. The participation rate is lower in calculus and lower than it should be in finite/discrete mathematics given the proportion of black students who major in computer science (see appendix table 3-10). If advisement could help influence the 22 percent who completed precalculus and help

Figure 3-1.
Representation index of racial/ethnic/gender categories in total college enrollment: 1980–1994, selected years



Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Text table 3-1.
Representation index of racial/ethnic/gender categories in total college enrollment: 1980, 1990–1994[1]

Racial/ethnic/gender category	1980	1990	1991	1992	1993	1994
White Males	100.3	99.0	97.4	95.8	95.1	93.6
Asian Males	159.4	127.2	132.1	134.7	135.6	139.4
Black Males	66.6	56.2	57.7	58.8	60.0	60.0
Hispanic Males	63.8	48.2	51.1	54.6	57.0	59.9
American Indian Males	98.8	81.4	84.2	86.0	87.8	90.0
White Females	110.9	123.9	123.1	122.4	121.6	121.1
Asian Females	152.1	129.9	136.7	141.1	142.3	146.5
Black Females	85.4	84.4	87.7	90.3	92.3	94.5
Hispanic Females	77.6	73.0	77.0	81.4	83.6	86.4
American Indian Females	126.3	119.1	124.2	124.2	126.2	131.5

[1] Data used in the calculations of these indices are presented in appendix tables 3-6, 3-7, and 3-8.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Students With Disabilities

National data about persons with disabilities in all fields at the undergraduate level is insufficient to measure and describe the magnitude of the problems they face. For a description of undergraduate students who reported a disability, see appendix table 3-16.

The reasons that students with disabilities may not be majoring in science, mathematics, and engineering (SME) in greater numbers were examined in a recent study (Seymour and Hunter, 1998) conducted at one U.S. university. The study (see "Technical Notes to Chapter 3" for details on the study and its participants) suggests students with disabilities might be more likely to complete degrees in these fields if changes were made in faculty attitudes, financial aid requirements, and time allowed for degree completion. The study, which is described here, also showed the important role a university's disability services office can play in negotiating accommodations for students with disabilities.

Students with disabilities are significantly underrepresented in undergraduate and graduate majors in SME curricula. At first glance, one of the main causes of this is not unlike those of other underrepresented groups: the reason lies in the structure and culture of SME teaching. Students with disabilities face many unique issues and barriers in achieving success. Many students with disabilities simultaneously have a high potential for success and are at risk of dropping out or switching to another field. They must overcome significant obstacles to complete a university SME education. The three major barriers common to SME undergraduates with disabilities are faculty attitudes regarding certain accommodations, some aspects of the financial aid system, and the limitations of the disability itself.

A strong interest in their discipline, focused career aspirations, and support and accommodation in the early stages of their studies are characteristics common to successful graduates within SME. One distinguishing characteristic of those who persist from those who leave, regardless of their gender, ethnicity, or disability, is the development of particular attitudes and strategies. Students with disabilities who are most successful have communicated their needs and have identified appropriate accommodation and support. They have developed a combination of persistence, excellent organizational skills, knowledge of assistive technology, and the ability to invoke the necessary support systems or agencies when dealing with barriers.

Faculty Attitudes

None of the Seymour and Hunter (1998) study participants recommended changes in the accommodation system administered by disability services offices. They did suggest that, in many cases, faculty attitudes had negative impact on the system and needed to be addressed.

Faculty responses to formal accommodation requests from students with disabilities included the following:

- Discounting the need for accommodation
- Refusing the accommodation as a way to "prepare" the student for "real world" competition
- Encouraging students to drop the class or change majors
- Placing the students in inappropriate testing places (subject to noise or periodic interruptions)
- Forgetting to send a test or not communicating changes or errors (if student arranged testing under disability services administration)
- Lowering grades for work done under accommodated conditions
- Insisting on knowing the nature of the student's disability, treatment, or medication in order to decide whether they will agree to the accommodation already requested and/or arranged by the disability services office
- Embarrassing student by talking about the disability or accommodations in front of peers

Study participants perceived, based on faculty responses to requests for accommodations, that some SME faculty "approved" certain conditions as "genuine disabilities" and exercised various degrees of skepticism about all others. The conclusion made by many students is that the rigors of the entirely unofficial process of approving accommodations already granted by the university has little to do with academic issues. For those faculty who act in the "gatekeeper" role, it may be seen as an appropriate way of testing for fitness to belong to the academic and professional communities based on SME disciplines. The essentially moral question raised by many requests for accommodations is if in granting it a student with a disability would be given an unfair advantage over other students.

Students With Disabilities *(continued)*

Financial Aid

The main difficulties of students who sought support through the university's financial aid office were that the rules that apply to all financial aid recipients do not make allowances for carrying less than a full class load, the nature of the disability, its variability or unpredictability, the effects of particular medications, problems of fatigue, and unexpected crises of mobility and transportation. These are issues which can make a full complement of classes very difficult or impossible for many students with disabilities. Taking a full load to qualify for financial aid very commonly creates a pattern of "incompletes," failures, and temporary withdrawals.

Some students in this study believed they would have spent less time, energy, and money repeating classes had they been allowed to work at a pace commensurate with the constraints of their disability.

Attrition and the Stop-Go Phenomenon

Although the attrition rate of students with disabilities appears comparable with those of students of color, there are major differences. The "attrition" of students with disabilities is often temporary, more of a stop-go pattern to their progress rather than an abandonment of their education or their field.

Approximately one-third of the undergraduates in the study reported feeling sufficiently discouraged to consider leaving either their major or their institution. Four related issues recurred in the explanations of undergraduates with disabilities who were considering leaving or who had left: financial problems; intermittent troubles due to the disability; accumulation of "incompletes" in the record, related both to the disability and financial difficulties; and accommodation difficulties.

Most students with disabilities resumed their studies once a specific disability setback and/or their financial situation had improved, or they were able to resolve problems with their academic record. This is not, however, a pattern indicated in the SME attrition rates of students of color, women, or white males. Because time out of school was reported by the undergraduates with disabilities themselves to be, typically, one semester, the overall time taken to complete SME majors (i.e., a little over 5 years) is similar to time taken by those students without disabilities.

Disability as a "Disadvantage of Time"

Coping with time-related problems was a universal feature of the experience of all study participants. It distinguishes their circumstances from those of other SME majors, is a facet of every type of barrier they encounter, and transcends differences of students with disabilities of different types. The time issues that participants raised were of five broad types: problems of pace; speed of learning, comprehension, and recall; temporal disruptions in physical and mental functions; time-related educational needs; and time expended in coping with difficulties raised by their disabilities.

Because SME faculty usually measure academic success (as opposed to demonstrations of knowledge and comprehension in other forms) by specific standards and time-related criteria, the slower pace at which students with many types of disabilities must work becomes a critical disadvantage. Students with learning and other disabilities must find alternative ways to absorb and apply class materials. Fluctuations in a disability or the side effects of medication may prevent students from concentrating on their studies. Basic educational requirements and activities of daily living take more time. Coping with these difficulties can be frustrating and take valuable time away from studies.

Disability Services

To meet the needs of students with all types of disabilities, a university's Disability Services Office can play a significant role in helping to negotiate accommodations among students, faculty, university administration, and outside agencies. Students with disabilities identified the following Disability Services-arranged services and accommodations as having special value: preregistration, arranging priority access to particular classes, changing inaccessible or remote classrooms, getting textbooks recorded prior to the start of classes, arranging special test accommodations, and assistance in locating and trying out assistive technology.

move more of them forward into calculus, participation rates in the physical sciences might be higher.

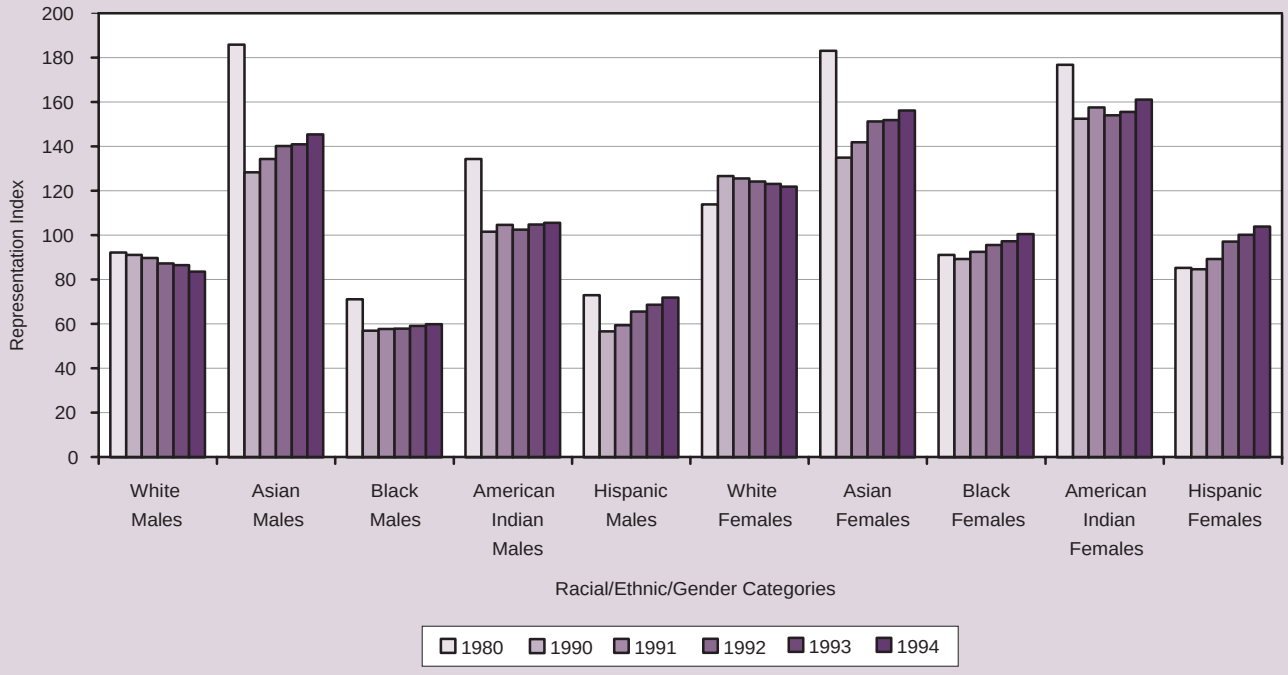
- Black students also show enrollment patterns in which physical science is more likely covered through an elective course rather than a required course. If students choose to maintain this pattern, these students will not reach intermediate-level knowledge in specific physical science disciplines.
- In general, Hispanic students have a stronger participation profile in the physical sciences than they do in the life sciences.

A similar picture of the course taking among those students taking courses primarily in 2-year institutions did not yield results rich enough for convincing analyses of the differences by race/ethnicity. There is no question that, when transfer students are excluded, however, the remaining group shows distinct gender differences in participation patterns. Appendix table 3-11 clearly shows this pattern of gender differences in technical mathematics (men) versus business mathematics (women), introductory computer science (men) versus data processing (women), and computer technology courses (men) versus the biology courses taken as part of associate's degree programs in nursing and allied health.

Although analysis of course taking by students in 2-year institutions is not feasible, detailed analyses were made of patterns of representation of racial/ethnic and gender categories among persons attending 2-year colleges. Analyses were made for the total enrollment of 2-year colleges in the United States. It is noted that racial/ethnic and gender patterns of total enrollment at 2-year colleges are similar to patterns of full-time enrollment at these institutions. (See appendix tables 3-12 and 3-13.)

The representation of white males among the 2-year college population has been proportionally decreasing since 1980. (See figure 3-2, text table 3-2, and appendix tables 3-14 and 3-15.) In fact, by 1994 only white males, black males, and Hispanic males had IR scores less than 100. The other groups are attending 2-year colleges at a higher rate than their population proportions would suggest. Since 1990, the 2-year college enrollment IR scores of Hispanic males and females, Asians males and females, and black females have been increasing dramatically. The IR scores for American Indian females, already at a high level, have increased slightly during the 1990s. The IR scores for black males have increased slightly. As of 1994, black males had the lowest proportional representation among persons attending 2-year institutions. (See appendix tables 3-12 and 3-13.)

Figure 3-2.
Representation index of racial/ethnic/gender categories in the total enrollment at 2-year institutions: 1980, 1990–1994



Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Text table 3-2.
Representation index of racial/ethnic/gender categories in the total enrollment at 2-year institutions: 1980, 1990–1994[1]

Racial/ethnic/gender category	1980	1990	1991	1992	1993	1994
White Males	92.2	91.0	89.7	87.3	86.4	85.0
Asian Males	185.9	128.4	134.4	140.1	140.9	145.4
Black Males	71.1	56.9	57.7	57.9	59.0	59.9
Hispanic Males	73.0	56.6	59.4	65.5	68.6	71.8
American Indian Males	134.3	101.6	104.6	102.4	104.7	105.5
White Females	113.9	126.7	125.5	124.2	123.1	121.8
Asian Females	183.1	135.0	141.8	151.3	151.8	156.1
Black Females	91.0	89.2	92.4	95.5	97.3	100.4
Hispanic Females	85.2	84.6	89.2	97.1	100.2	103.9
American Indian Females	176.7	152.5	157.6	153.9	155.6	161.1

[1] Data used in the calculations of these indices are presented in appendix tables 3-14 and 3-15.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Four-Year Institutions

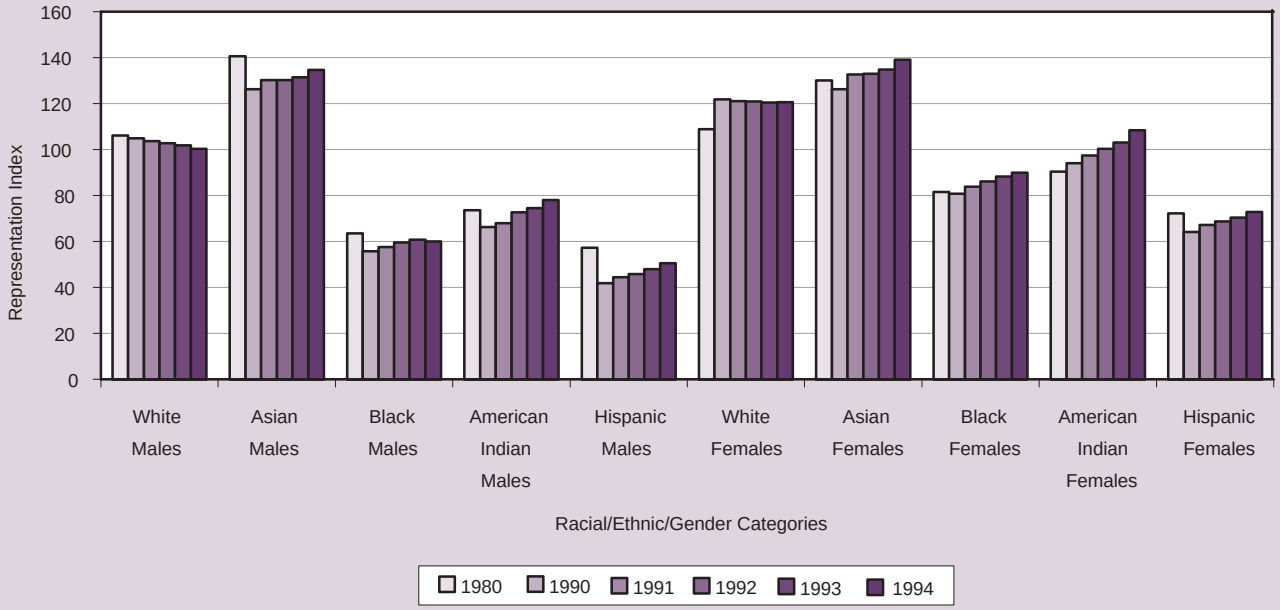
Although full-time enrollment at all undergraduate institutions has risen over the past 20 years (see appendix table 3-17), the enrollment of white men enrolled full time in 4-year institutions has declined by 10 percent from 1976 to 1994. At the same time, the enrollment of white women has remained almost constant (38 percent of total full-time enrollment at 4-year institutions). During the same period, the enrollment of all racial/ethnic minority groups has risen. The most notable increases in total full-time enrollment at all institutions during that period were for women, who increased from 46 percent to 54 percent; Hispanic students, who grew from 4 percent to 8 percent of the total full-time fall enrollment; and Asian students, who constituted 2 percent of the total full-time enrollment in fall 1976 and 6 percent in fall 1994. Racial/ethnic and gender patterns among total enrollment at 4-year institutions are similar to those for full-time enrollment at these institutions (see appendix tables 3-18 and 3-19).

The representation of the racial/ethnic and gender groups in 4-year institutions is similar to that in 2-year institutions in that there are more Asian males and females in both types of institutions than would be expected from their proportion in the population (see figure 3-3, text table 3-3, and appendix tables 3-20 and 3-21). This unexpected level was also found among American Indian females enrolled in 2-year institutions from 1980 through 1994. Although this group of American Indian females was underrepresented in 4-year institutions in 1980, since then it has increased its representation in these institutions and has achieved parity since 1992.

Additional findings from the IR analysis of particular interest are

- The representation of white males in both types of institutions has decreased since 1980, yet in 1994, white males were at parity in 4-year institutions.
- Hispanic males and females have increased their representation in 4-year institutions, although not to the same extent as they have done in 2-year institutions.
- Hispanic females achieved parity at 2-year institutions in 1993 and 1994; their IR score for enrollment in 4-year institutions was slightly less than 73 in 1994.
- The proportional representation of black males in 4-year institutions is about the same as it is in 2-year institutions, ranging from an IR score of slightly less than 56 to 60 during the 1990s. Black males have made very little progress in their enrollment patterns at both types of institutions.

Figure 3-3.
Representation index of racial/ethnic/gender categories in the total enrollment of undergraduate students at 4-year institutions: 1980, 1990–1994



Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Text table 3-3.
Representation index of racial/ethnic/gender categories in the total enrollment of undergraduate students at 4-year institutions: 1980, 1990–1994[1]

Racial/ethnic/gender category	1980	1990	1991	1992	1993	1994
White males	106.1	104.9	103.6	102.7	101.9	100.4
Asian males	140.6	126.3	130.3	130.3	131.4	134.7
Black males	63.5	55.7	57.6	59.5	60.7	60.0
Hispanic males	57.3	41.9	44.5	45.8	47.9	50.6
American Indian males	73.6	66.3	67.9	72.7	74.4	78.0
White females	108.8	121.9	121.1	120.9	120.4	120.6
Asian females	130.1	126.2	132.6	133.0	134.8	139.0
Black females	81.5	80.7	83.9	86.1	88.3	90.0
Hispanic females	72.2	64.2	67.2	68.7	70.4	72.8
American Indian females	90.4	94.0	97.3	100.3	103.0	108.4

[1] Data used in the calculations of these indices are presented in appendix tables 3-20 and 3-21.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

- Although black females achieved parity at 2-year institutions in 1994, their IR score for 4-year institutions, though increasing, achieved only 90 in 1994.

Bachelor's Degrees

The percentage of women of all racial/ethnic groups who have been awarded bachelor's degrees in science and engineering has risen dramatically over the past 30 years. (See appendix table 3-2.)[3] In 1966, women received 25 percent of all science and engineering bachelor's degrees awarded and 52 percent of degrees in non–science-and-engineering fields. By 1995, women received almost half (47 percent) of all science and engineering bachelor's degrees awarded and 58.7 percent of all non–science-and-engineering bachelor's degrees awarded. During the decade of the 1980s, the total number of bachelor's degrees awarded to all groups, especially women, increased. In the 10-year period between 1984 and 1994, the number of bachelor's degrees awarded to men increased by 10 percent, whereas those awarded to women rose by 29 percent. (See appendix tables 3-2 and 3-3.)

For both 1994 and 1995, approximately 40 percent of the bachelor's degrees earned by white males, American Indian males, and Hispanic males were in science and engineering. Fifty-seven percent of the bachelor's degrees earned by Asian males and 36 percent of the degrees earned by black males were in science and engineering. (See text tables 3-4 and 3-5 and appendix table 3-4.)

In 1994 and 1995, 40 percent of the bachelor's degrees earned by Asian females were in science and engineering. The percentage of degrees in science and engineering among the other female categories range from 27 to 30 percent for both years; black females had a higher percentage than the other female racial/ethnic categories. (See appendix table 3-5.)

White males continue to earn more than 60 percent of the bachelor's degrees awarded in engineering. White women had the next highest percentage—12 percent—of the engineering bachelor's degrees awarded in 1994 and 1995. Nine percent of these degrees were earned by Asian males. For both years, the percentage of the engineering degrees earned by Hispanic males was slightly higher than the percentage of these degrees earned by black males. Less than 1 percent of these degrees were earned by American Indians.

[3] Nonresident aliens and persons whose race/ethnicity are unknown are excluded from these tables.

Differences among racial/ethnic and gender categories by field are considerable.

Physical, Computer, and Agricultural Sciences

- Fifty-four to 58 percent of the bachelor's degrees in these fields were earned by white males.
- White females earned 35 percent of the bachelor's degrees in agricultural science. They earned 27 percent of the bachelor's degrees in the physical sciences and 17 percent of the bachelor's degrees in computer science.
- Asian males earned 4 percent of the bachelor's degrees in the physical sciences and 7 percent of the degrees in computer science.
- Black males, Asian females, and black females each earned 3 percent of the bachelor's degrees in the physical sciences and 4 to 6 percent of the bachelor's degrees in computer science. Less than 1 percent of the bachelor's degrees in these areas were earned by American Indians.

Mathematics

There is a small difference between white males and females in their percentage of the total number of bachelor's degrees earned in mathematics.

- White males earned 44 percent of the bachelor's degrees in mathematics in 1994 and 42 percent in 1995.
- White females earned 38 percent of the bachelor's degrees in mathematics in both years.
- Asians and blacks, both males and females, earned essentially the same percentage of the degrees in mathematics (4 percent) in 1995. In 1994, Asian females and black males earned 3 percent.
- Two percent of the bachelor's degrees in mathematics were earned by Hispanics.
- Less than 1 percent were earned by American Indians.

Social Sciences

Differences between white males and females in social sciences are similar to those found in mathematics.

Text table 3-4.
Distribution of earned bachelor's degrees, by field, race, ethnicity, and gender: 1995

Field of degree	Total	White males	Asian males	Black males	Hispanic males	American Indian males	White females	Asian females	Black females	Hispanic females	American Indian females
Total	1,110,512	407,155	28,348	30,998	27,875	2,669	485,630	30,947	54,289	38,816	3,785
Engineering	57,228	36,785	5,340	1,846	2,895	176	6,941	1,445	999	756	45
Physical science	18,231	10,006	784	495	437	66	4,946	563	539	363	32
Mathematical science	12,897	5,456	519	476	315	29	4,887	446	519	221	29
Computer science	21,812	11,793	1,583	1,241	876	73	3,739	782	1,257	431	37
Biological science	54,277	19,790	3,467	981	1,340	128	20,838	3,576	2,250	1,750	157
Agricultural science	14,180	8,152	130	121	228	82	4,968	157	142	158	42
Social science	127,184	54,508	3,247	4,565	3,774	403	46,050	3,758	6,356	4,103	420
Psychology	69,936	15,241	969	1,402	1,166	120	40,673	2,362	4,339	3,377	287
Non-science and engineering	734,767	245,424	12,309	19,871	16,844	1,592	352,588	17,858	37,888	27,657	2,736
Percentage distributions within race/ethnic/gender categories:											
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Engineering	5.2%	9.0%	18.8%	6.0%	10.4%	6.6%	1.4%	4.7%	1.8%	1.9%	1.2%
Physical science	1.6%	2.5%	2.8%	1.6%	1.6%	2.5%	1.0%	1.8%	1.0%	0.9%	0.8%
Mathematical science	1.2%	1.3%	1.8%	1.5%	1.1%	1.1%	1.0%	1.4%	1.0%	0.6%	0.8%
Computer science	2.0%	2.9%	5.6%	4.0%	3.1%	2.7%	0.8%	2.5%	2.3%	1.1%	1.0%
Biological science	4.9%	4.9%	12.2%	3.2%	4.8%	4.8%	4.3%	11.6%	4.1%	4.5%	4.1%
Agricultural science	1.3%	2.0%	0.5%	0.4%	0.8%	3.1%	1.0%	0.5%	0.3%	0.4%	1.1%
Social science	11.5%	13.4%	11.5%	14.7%	13.5%	15.1%	9.5%	12.1%	11.7%	10.6%	11.1%
Psychology	6.3%	3.7%	3.4%	4.5%	4.2%	4.5%	8.4%	7.6%	8.0%	8.7%	7.6%
Non-science and engineering	66.2%	60.3%	43.4%	64.1%	60.4%	59.6%	72.6%	57.7%	69.8%	71.3%	72.3%
Percentage distributions within field of degree categories:											
Total	100.0%	36.7%	2.6%	2.8%	2.5%	0.2%	43.7%	2.8%	4.9%	3.5%	0.3%
Engineering	100.0%	64.3%	9.3%	3.2%	5.1%	0.3%	12.1%	2.5%	1.7%	1.3%	0.1%
Physical science	100.0%	54.9%	4.3%	2.7%	2.4%	0.4%	27.1%	3.1%	3.0%	2.0%	0.2%
Mathematical science	100.0%	42.3%	4.0%	3.7%	2.4%	0.2%	37.9%	3.5%	4.0%	1.7%	0.2%
Computer science	100.0%	54.1%	7.3%	5.7%	4.0%	0.3%	17.1%	3.6%	5.8%	2.0%	0.2%
Biological science	100.0%	36.5%	6.4%	1.8%	2.5%	0.2%	38.4%	6.6%	4.1%	3.2%	0.3%
Agricultural science	100.0%	57.5%	0.9%	0.9%	1.6%	0.6%	35.0%	1.1%	1.0%	1.1%	0.3%
Social science	100.0%	42.9%	2.6%	3.6%	3.0%	0.3%	36.2%	3.0%	5.0%	3.2%	0.3%
Psychology	100.0%	21.8%	1.4%	2.0%	1.7%	0.2%	58.2%	3.4%	6.2%	4.8%	0.4%
Non-science and engineering	100.0%	33.4%	1.7%	2.7%	2.3%	0.2%	48.0%	2.4%	5.2%	3.8%	0.4%

NOTE: These data exclude nonresident aliens and U.S. citizens and permanent residents for whom their race/ethnicity was unknown.
SOURCE: National Science Foundation, Science and Engineering Degrees, by Race/Ethnicity of Recipients, 1987–1994, (NSF 96-329) (Arlington, VA, 1996).

Text table 3-5.
Distribution of earned bachelor's degrees, by field, race, ethnicity, and gender: 1994

Field of degree	Total	White males	Asian males	Black males	Hispanic males	American Indian males	White females	Asian females	Black females	Hispanic females	American Indian females
Total	1,123,862	420,211	26,420	30,106	25,860	2,562	497,913	28,255	52,210	36,823	3,502
Engineering	57,223	37,830	5,235	1,784	2,495	179	6,857	1,281	875	648	39
Physical science	17,449	9,958	648	464	415	52	4,658	448	457	318	31
Mathematical science	13,609	5,920	523	457	300	29	5,169	403	535	243	30
Computer science	21,674	12,022	1,476	1,161	719	59	3,794	771	1,237	416	19
Biological science	50,028	18,882	2,992	927	1,298	112	19,060	2,967	2,053	1,603	134
Agricultural science	12,619	7,333	82	137	193	66	4,400	91	131	143	43
Social science	132,989	58,409	3,204	4,644	3,774	395	48,454	3,522	6,191	3,974	422
Psychology	67,267	14,891	807	1,232	996	113	39,979	1,970	4,004	2,994	281
Non-science and engineering	751,004	254,966	11,453	19,300	15,670	1,557	365,542	16,802	36,727	26,484	2,503
Percentage distributions within race/ethnic/gender categories:											
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Engineering	5.1%	9.0%	19.8%	5.9%	9.6%	7.0%	1.4%	4.5%	1.7%	1.8%	1.1%
Physical scienc	1.6%	2.4%	2.5%	1.5%	1.6%	2.0%	0.9%	1.6%	0.9%	0.9%	0.9%
Mathematical science	1.2%	1.4%	2.0%	1.5%	1.2%	1.1%	1.0%	1.4%	1.0%	0.7%	0.9%
Computer science	1.9%	2.9%	5.6%	3.9%	2.8%	2.3%	0.8%	2.7%	2.4%	1.1%	0.5%
Biological science	4.5%	4.5%	11.3%	3.1%	5.0%	4.4%	3.8%	10.5%	3.9%	4.4%	3.8%
Agricultural science	1.1%	1.7%	0.3%	0.5%	0.7%	2.6%	0.9%	0.3%	0.3%	0.4%	1.2%
Social science	11.8%	13.9%	12.1%	15.4%	14.6%	15.4%	9.7%	12.5%	11.9%	10.8%	12.1%
Psychology	6.0%	3.5%	3.1%	4.1%	3.9%	4.4%	8.0%	7.0%	7.7%	8.1%	8.0%
Non-science and engineering	66.8%	60.7%	43.3%	64.1%	60.6%	60.8%	73.4%	59.5%	70.3%	71.9%	71.5%
Percentage distributions within field of degree categories:											
Total	100.0%	37.4%	2.4%	2.7%	2.3%	0.2%	44.3%	2.5%	4.6%	3.3%	0.3%
Engineering	100.0%	66.1%	9.1%	3.1%	4.4%	0.3%	12.0%	2.2%	1.5%	1.1%	0.1%
Physical science	100.0%	57.1%	3.7%	2.7%	2.4%	0.3%	26.7%	2.6%	2.6%	1.8%	0.2%
Mathematical science	100.0%	43.5%	3.8%	3.4%	2.2%	0.2%	38.0%	3.0%	3.9%	1.8%	0.2%
Computer science	100.0%	55.5%	6.8%	5.4%	3.3%	0.3%	17.5%	3.6%	5.7%	1.9%	0.1%
Biological science	100.0%	37.7%	6.0%	1.9%	2.6%	0.2%	38.1%	5.9%	4.1%	3.2%	0.3%
Agricultural science	100.0%	58.1%	0.6%	1.1%	1.5%	0.5%	34.9%	0.7%	1.0%	1.1%	0.3%
Social science	100.0%	43.9%	2.4%	3.5%	2.8%	0.3%	36.4%	2.6%	4.7%	3.0%	0.3%
Psychology	100.0%	22.1%	1.2%	1.8%	1.5%	0.2%	59.4%	2.9%	6.0%	4.5%	0.4%
Non-science and engineering	100.0%	34.0%	1.5%	2.6%	2.1%	0.2%	48.7%	2.2%	4.9%	3.5%	0.3%

NOTE: These data exclude nonresident aliens and U.S. citizens and permanent residents for whom their race/ethnicity was unknown.
SOURCE: National Science Foundation, Science and Engineering Degrees, by Race/Ethnicity of Recipients, 1987–1994, NSF 96-329 (Arlington, VA, 1996).

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

- White males earned 44 percent of the bachelor's degrees in social sciences earned in 1994 and 43 percent in 1995.
- Five percent of the bachelor's degrees in social sciences went to black females.
- Asian males and females and black males each earned around 2 percent of the bachelor's degrees in social sciences during these 2 years.
- Three percent of the bachelor's degrees in social sciences were earned by Hispanics.
- Less than 1 percent of degrees in social sciences were earned by American Indians.

Psychology

- For both 1994 and 1995, almost 60 percent of the bachelor's degrees earned in psychology were earned by white females.
- White males earned 22 percent of these degrees.
- Six percent of the degrees were earned by black females, and 3 percent were earned by Asian females. Females in Hispanic and American Indian categories earned less than 2 percent of the degrees in psychology in 1994 and 1995.

Indices of Representation

Indices of Representation were computed to assess the relative representation of racial/ethnic and gender groups in the awarding of bachelor's degrees. (See text tables 3-6 and 3-7 and appendix tables 3-22, 3-23, and 3-24.) In 1994, considering all fields, three of the ten racial/ethnic and gender categories had an IR score of 100 or greater: white males and females and Asian females. (See text tables 3-6 and 3-7 and appendix table 3-22.) Asian males had an IR score slightly less than 100, and American Indian females had an IR score of slightly more than 90. The scores for 1995 are not substantially different from the scores for 1994. Black males had the lowest IR scores for both 1994 and 1995.

The racial/ethnic and gender groups differ a great deal when their IR scores within fields of study are compared.

Engineering

- Asian males are highly overrepresented in engineering, indicating that for 1994 and 1995 their proportion among persons earning bachelor's degrees in engineering was well over three times their proportion among full-time, first-time, first-year college students.
- All of the male racial/ethnic categories, except black males, have IR scores in engineering higher than 100 for these 2 years. Asian females have IR scores just below 100 for the 2 years.
- In 1994 and 1995, except for Asian females, females in each racial/ethnic category had IR scores for bachelor's degrees in engineering of less than 32.

Physical Sciences and Mathematics

- For both 1994 and 1995, the IR scores of Asians (both males and females), American Indian males, and white males are higher than 100 for bachelor's degrees in the physical sciences and mathematical sciences.
- White females are not far away from parity in earning bachelor's degrees in mathematical sciences.

Computer Sciences

- In 1994 and 1995, Asian males had the highest IR score for bachelor's degrees in the computer sciences. They are followed by Asian females and white males.
- The proportion of degrees in computer sciences earned by black males and Hispanic males in 1994 and 1995 was higher than their proportion among full-time, first-time, first-year students in 1990.
- In 1995, all the male racial/ethnic categories had an IR over 100 for degrees in the computer sciences.
- Black females had an IR score below parity for both years, but those scores were much higher than those of Hispanic females, white females, and American Indian females.

Biological Sciences

- Asian males and females earned bachelor's degrees in 1994 and 1995 in the biological sciences at a rate that was over two times their proportion among full-time, first-time, first-year students in 1990 and 1991.
- The proportion of white males among those earning bachelor's degrees in 1994 and 1995 in the biological sciences was slightly higher than their proportion among full-time, first-time, first-year students in 1990 and 1991, respectively.

Text table 3-6.

Representation index of racial/ethnic/gender categories in earned bachelor's degrees by field: 1994 [1]

Race/ethnicity/gender	All fields	Engineering	Physical sciences	Mathe-matical sciences	Computer sciences	Biological sciences	Agricultural sciences	Social sciences	Psychology	Non-science and engineering
White, non-Hispanic males	101.5	179.4	154.9	118.1	150.5	102.4	157.7	119.2	60.1	92.1
Asian or Pacific Islander males	98.9	384.8	156.2	161.6	286.4	251.5	27.3	101.3	50.5	64.1
Black, non-Hispanic males	57.9	67.4	57.4	72.5	115.7	40.0	23.5	75.4	39.6	55.5
Hispanic males	76.2	144.5	78.8	73.0	109.9	86.0	50.7	94.0	49.1	69.1
American Indian or Alaskan Native males	79.0	108.4	103.2	73.8	94.3	77.5	181.2	102.9	58.2	71.8
White, non-Hispanic females	110.9	30.0	66.8	95.1	43.8	95.4	87.3	91.2	148.8	121.8
Asian or Pacific Islander females	105.9	94.3	108.2	124.8	149.9	249.9	30.4	111.6	123.4	94.3
Black, non-Hispanic females	72.1	23.7	40.6	61.0	88.5	63.7	16.1	72.2	92.3	75.9
Hispanic females	87.7	30.3	48.8	47.8	51.4	85.8	30.3	80.0	119.1	94.4
American Indian or Alaskan Native females	93.2	20.4	53.1	65.9	26.2	80.1	101.9	94.9	124.9	99.7

[1] Data used in the calculations of these indices are presented in appendix table 3-22.

NOTE: These data exclude nonresident aliens and U.S. citizens and permanent residents for whom their race/ethnicity was unknown.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Text table 3-7.

Representation index of racial/ethnic/gender categories in earned bachelor's degrees by field: 1995[1]

Race/ethnicity/gender	All fields	Engineering	Physical sciences	Mathe-matical sciences	Computer sciences	Biological sciences	Agricultural sciences	Social sciences	Psychology	Non-science and engineering
White, non-Hispanic males	102.0	178.9	152.8	117.7	150.5	101.5	160.0	119.3	60.7	93.0
Asian or Pacific Islander males	102.0	372.9	171.9	160.8	290.0	255.3	36.6	102.0	55.4	66.9
Black, non-Hispanic males	57.4	66.3	55.8	75.8	116.9	37.1	17.5	73.8	41.2	55.6
Hispanic males	75.7	152.6	72.3	73.7	121.1	74.5	48.5	89.5	50.3	69.1
American Indian or Alaskan Native males	82.2	105.2	123.8	76.9	114.4	80.6	197.7	108.3	58.7	74.1
White, non-Hispanic females	111.2	30.8	69.0	96.4	43.6	97.6	89.1	92.1	147.9	122.0
Asian or Pacific Islander females	105.8	95.9	117.3	131.3	136.1	250.2	42.0	112.2	128.2	92.3
Black, non-Hispanic females	73.6	26.3	44.5	60.6	86.7	62.4	15.1	75.2	93.4	77.6
Hispanic females	84.5	31.9	48.1	41.4	47.8	78.0	26.9	78.0	116.8	91.0
American Indian or Alaskan Native females	94.7	21.8	48.8	62.5	47.1	80.4	82.3	91.8	114.0	103.5

[1] Data used in the calculations of these indices are presented in appendix table 3-23.

NOTE: These data exclude nonresident aliens and U.S. citizens and permanent residents for whom their race/ethnicity was unknown.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

- The IR score of white females for 1994 and 1995 indicated that they were just below parity in degrees earned in the biological sciences.

Agricultural Sciences

- American Indian males have the highest IR score among the racial/ethnic and gender groups for earning bachelor's degrees in agricultural sciences in 1994 and 1995.
- White males had an IR score well above parity for these 2 years.
- With the exception of white females and American Indian females, the IR scores of the other racial/ethnic and gender groups were low for both 1994 and 1995.

Social Sciences

- White males, Asian males and females, and American Indian males had IR scores above 100 for degrees in social sciences in 1994 and 1995.
- The IR scores for the other racial/ethnic and gender categories for degrees in social sciences ranged between 72 and 95 for these 2 years.
- Not one racial/ethnic and gender category has an extremely low IR score for degrees in social sciences.

Psychology

- For 1994 and 1995, not one male racial/ethnic category has an IR score higher than 61.
- Except for black females, every female category has an IR score for psychology that is higher than 100 for both 1994 and 1995.
- Black females had an IR score in the 90s for these 2 years.

Non–Science-and-Engineering

- White females had an IR score around 122 for degrees in non–science-and-engineering fields in both 1994 and 1995.
- American Indian females had a score essentially at parity in 1994 and slightly more than parity in 1995 for degrees in non–science-and-engineering areas.
- White males and Asian females had an IR score in the lower 90s in both 1994 and 1995 for degrees in non–science-and-engineering areas.
- The IR scores for the other three racial/ethnic and gender categories ranged from slightly less than 56 to slightly less than 78.

Mathematics and Science Experiences of Young Women

Young women in the United States continue to be more likely than young men to stop taking courses, earn lower grades, and lose interest in mathematics and science during the high school years. As early as 7th grade, girls are less likely than boys to aspire to mathematics and science jobs or to believe science knowledge is needed for a good job.

When the mathematics and science experiences of women in race and class subgroups are examined, class affects these experiences in an expected manner. For example, women from upper SES (socioeconomic status) families are over three times as likely as those from lower SES families to have scored in the upper quartile on mathematics and science achievement indicators at some time during their high school years. Race, however, does not always work in the expected way. In fact, equally qualified black women are more likely to have positive mathematics and science achievement and to be taking mathematics and science courses than are their white counterparts. Analyses of these young black women's resources suggests that their advantage may come from mothers who have high expectations and are very involved in their daughters' lives.

An understanding of gender and science requires a longitudinal look at experiences in multiple areas of mathematics and science. Ebbs and flows in science interest and aptitude are common. Most women do not permanently leave the science pipeline until the post–high-school years.

— Sandra L. Hanson, Associate Professor of Sociology, Catholic University, Adapted from *Lost Talent: Women in the Sciences*

The Engineering Path[4]

Research conducted by the U.S. Department of Education examines the routes students take to earn an undergraduate degree in engineering.[5] In its most elaborate configuration, this route, or engineering path (EPATH) sets forth 11 "stations beyond the threshold" for bachelor's degree candidates. Each station describes student history (for example, "Mediocre Performance, Leaves Engineering for a different science, mathematics, engineering, or technology (SMET) field" or "Completes Bachelor's in Engineering, Architecture, or Engineering Technology and Continues to Graduate School in a non-SMET field").

Text table 3-8 aggregates these heuristics for academic career histories into three stations and compares men and women. The story told by these and allied data is complex. On the one hand, the academic background of women, particularly in mathematics, was stronger than for men. At the same time, however, their degree completion rate in engineering

[4] The data used in this analysis come from a national age-cohort longitudinal study and rely heavily on the college transcripts of participants in that study. That study, conducted over 13 years by the National Center for Education Statistics, followed the high school graduating class of 1982, known as the High School and Beyond Sophomore Cohort (HS&B/So). The college transcripts were gathered in 1993, when the members of this cohort were 29 to 30 years old.

[5] Engineering path (EPATH) is an empirically derived model for describing what happens to all students who cross a curricular threshold that would qualify them to pursue degrees in engineering, architecture, or engineering technologies. For a full explication, see Adelman, C., *Women and Men of the Engineering Path: A Model for Analysis of Undergraduate Careers*. Washington, DC: U.S. Department of Education and the National Institute for Science Education, 1998.

Text table 3-8.
Students who reached at least the threshold of the engineering curriculum in 4-year colleges, by gender, progress in engineering, and selected high school background characteristics: 1982–1993 cohort

Gender	Progress in Engineering		
	Completed only threshold courses in engineering	Took engineering courses beyond threshold but left engineering	Completed bachelor's in engineering, architecture, or engineering technologies
Academic career history (row percentages)[1]			
Men	18.3	20.0	61.6
Women	22.7	35.4	41.9
Percent who had planned to major in engineering when in high school:			
Men	64.22	60.52	72.8
Women	59.82	56.02	53.8
Percent who had completed calculus in high school:			
Men	20.2	21.22	25.7
Women	60.4	Low N [2]	36.3

[1] Because of rounding, rows may not add to 100 percent.
[2] Male/female comparisons are not statistically significant.

NOTES: Universe: All students who reached at least the threshold of the engineering curriculum in 4-year colleges. Weighted N = 149,841. Degree completion covers engineering, architecture, and engineering technologies.

SOURCE: NCES, High School and Beyond/Sophomore Cohort, 1982–1993 Cohort

The Engineering Path *(continued)*

was significantly lower, even though the grade-point averages (GPAs) of female degree-completers were almost identical to those of men (men: 2.88, standard deviation = .561; women: 2.98, standard deviation = .437). Among degree completers, a far lower percentage of women had planned to major in engineering when they were seniors in high school, suggesting that some programs have been successful in changing women's attitudes toward the field.

Over a third (35.4 percent) of the women who reached the curricular threshold continued, but then changed fields. Compared to men who left the engineering path, this group had slightly weaker mathematics backgrounds and slightly lower GPAs (2.71 to 2.83), but a much higher proportion of bachelor's degree completers (80 percent for women versus 60 percent for men). Where did they go? The physical sciences (not the life sciences) and computer science took most (44 percent) of the women who left engineering and completed bachelor's degrees in other fields. (See text table 3-9.) These choices may reflect prior academic investments in mathematics and interest in more theoretical SMET fields.

Text table 3-9.
Major fields of those who left engineering but completed bachelor's degrees: 1982–1993 cohort, by gender [percentage distribution]

Major field	Men	Women	All
Computer science	31.4	14.3	27.1
Business (including accounting, finance, marketing, etc.)	25.4	14.9	22.7
Physical sciences	17.3	29.5	20.4
Social sciences	11.41	Low N[1]	10.91
Life sciences	Low N[1]	15.11	6.2
All other	11.31	17.01	12.7

[1] Male/female comparisons are not statistically significant.

SOURCE: NCES, High School and Beyond/Sophomore Cohort, 1982–1993 Cohort

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

—Clifford Adelman, Senior Research Analyst, U.S. Department of Education

Changes in Course Participation, 1972–1993

College transcripts from two longitudinal studies sponsored by the U.S. Department of Education's National Center for Education Statistics provide the basis for generating time-series data on college course taking.[6] The analysis focuses on students who primarily attend 4-year institutions. Text table 3-10 displays the changes in the proportion of students in each cohort who completed courses in four key categories of mathematics. (There are 20 course categories in the mathematics taxonomy used in these studies.) With few exceptions, participation rates increased for all subgroups in all four of the categories. A principal reason for this expansion may lie in a jump in the proportion of bachelor's degree recipients majoring in business fields from 17 percent to 25 percent; simultaneously, the mathematics requirements for business degrees increased.

Nonetheless, with respect to participation, the following conclusions can be reached:

- Women reached virtual "participation parity" with men in college algebra and statistics taught in mathematics departments.
- The ratio of men to women completers of calculus courses dropped from 2.43:1 to 1.75:1. There is another category of calculus course not included in this table, "Calculus for Life Sciences, Economics, or Business," in which women reached near participation parity with men (for the High School and Beyond/Sophomore Cohort, 4.3 percent of women completed this "applied calculus" course compared to 4.8 percent of men).
- Among underrepresented racial/ethnic groups, Hispanic students evidence the most dramatic increase in participation in calculus; black students have the lowest participation rate.

[6] The first of these cohorts was the high school graduating class of 1972 (NLS-72); the second was the high school graduating class of 1982 (High School and Beyond/Sophomore Cohort). The college records of these two cohorts, gathered at approximately age 30 in both cases, cover the period from 1972 to 1993. There are some striking differences in the undergraduate course participation rates of students in these two cohorts.

Changes in Course Participation, 1972–1993 *(continued)*

Text table 3-11 shows the proportion of students reaching midlevel course work in key laboratory sciences. The midlevel courses were chosen to illustrate the extent to which students from different groups persist beyond introductory courses. Because the courses are midlevel, the percentage of students taking them will be comparatively small. Where there are major changes in these percentages, for example in genetics or organic chemistry, it must be determined whether these changes are caused by changes in fields of concentration. Partly for this reason, the courses selected are generally less dependent on a student's major than others. Such courses as microbiology, anatomy and physiology, or organic biochemistry (all of which are part of the Nursing curriculum) were not selected for this analysis because they distort the issue of women's participation in science beyond the introductory level. Nursing and allied sciences, like engineering, are still gender-segmented fields.[7]

There were considerable declines in participation rates in both basic and midlevel laboratory science courses from 1972 to 1982, a trend in the opposite direction of that in mathematics. In text table 3-11, these declines are noticeable in both genetics and organic chemistry, particularly among men. Only among Asian students did participation rates not decline.

[7] Of the courses selected, organic chemistry is somewhat of an outlier because it is a de facto "service course" for premeds, regardless of major. The same cannot be said for genetics, physiological psychology, or biochemistry.

Text table 3-10.
Percent of 4-year college students who completed key mathematics courses, in two age cohorts

Course, gender, and race/ethnicity	1972–1984 Cohort	1982–1993 Cohort
College algebra		
Men	19.8	26.7
Women	12.9	24.9
White	16.8	26.1
Asian	Small sample[1]	16.5
Black	17.1	26.1
Hispanic	18.3	21.5
Precalculus		
Men	22.3	26.5
Women	11.6	17.9
White	17.8	21.7
Asian	32.3	48.7
Black	12.1	22.1
Hispanic	12.4	15.5
Statistics[2]		
Men	22.7	27.4
Women	17.1	24.7
White	20.4	26.9
Asian	34.1	28.5
Black	17.0	20.5
Hispanic	16.1	20.9
Calculus		
Men	34.5	40.3
Women	14.2	23.0
White	25.9	32.2
Asian	49.1	63.3
Black	14.5	18.5
Hispanic	16.1	26.3

[1] Sample size insufficient to produce a reliable estimate.
[2] Statistics courses include only those offered in mathematics departments.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Text table 3-11.
Percent of 4-year college students who completed selected midlevel laboratory science courses, in two age cohorts

Course, gender, and race/ethnicity	1972–1984 Cohort	1982–1993 Cohort
Biochemistry		
Men	6.5	4.4
Women	5.6	5.5
White	6.2	4.8
Asian	10.2	15.9
Black	4.2	3.8
Hispanic	Small sample[1]	4.5
Genetics		
Men	10.7	6.2
Women	7.8	5.8
White	9.3	6.1
Asian	12.9	12.9
Black	7.9	3.8
Hispanic	7.3	Small sample[1]
Organic chemistry		
Men	16.1	9.6
Women	10.6	9.6
White	13.5	9.5
Asian	22.5	24.8
Black	10.2	7.3
Hispanic	11.5	5.6
Physiological psychology		
Men	2.7	3.2
Women	3.9	4.2
White	3.4	3.7
Asian	8.7	8.9
Black	Small sample[1]	2.2
Hispanic	Small sample[1]	5.8

[1] Sample size insufficient to produce a reliable estimate.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Baccalaureate Origins of Black Women Earning Doctorates

Historically Black Colleges and Universities (HBCUs) play a critical role in educating black women who go on to earn doctorates in science and engineering. A study examining the baccalaureate origins of 1,465 black women who went on to earn doctoral degrees between 1975 and 1992 in the fields of biological sciences, physical sciences, and the social sciences noted that, in 1992, black women earned 49 percent of the science and engineering (S&E) doctorates awarded to black U.S. citizens (Leggon and Pearson, 1997). Of these, the greatest number earned was in the social sciences (1,217), followed by the biological sciences (211), and the physical sciences (37).

Across fields, 52 percent earned their undergraduate degrees from predominantly white colleges and universities (PWCUs), 38 percent from HBCUs, and 10 percent from women's colleges, but there were significant differences by field.

Among black women earning doctorates in the biological sciences, almost 75 percent earned undergraduate degrees from HBCUs. Of the remaining 25 percent, half received bachelor's degrees from PWCUs and half from women's colleges. A similar pattern holds for black women earning doctorates in the physical sciences. Slightly more than two-thirds had baccalaureate origins in HBCUs. Equal proportions of the remaining one-third had such origins in women's colleges and PWCUs.

For those in the social sciences, almost 60 percent earned the baccalaureate from PWCUs; approximately 30 percent from HBCUs; and less than 10 percent from women's colleges. Of the 27 biological scientists earning undergraduate degrees in women's colleges, 18, or two-thirds, earned them from the two historically black women's colleges—Spelman and Bennett. Of the six African American women earning a doctorate in the physical sciences between 1975 and 1992, four did so from Spelman College. Among the 115 African American women earning social science doctorates, Spelman and Bennett produced more than all of the Seven Sisters colleges—54 and 51, respectively.[8]

Across fields, Spelman and Bennett Colleges produced slightly more than half of the black women earning doctorates, the Seven Sisters produced approximately two-fifths, and other women's colleges produced one-tenth.

— Cheryl B. Leggon, Wake Forest University

The continuing importance of HBCUs to the undergraduate science and engineering education of black men and women, whether or not they go on to earn doctorates, can be seen in text tables 3-12 to 3-14.

[8] The "Seven Sisters" colleges are Barnard, Bryn Mawr, Mount Holyoke, Radcliffe, Smith, Wellesley, and Vassar (now coed).

Text table 3-12.
Percentage of all science and engineering bachelor's degrees awarded to blacks by HBCUs, by field, selected years: 1987–1994

Year	Engineering	Physical sciences	Mathematics	Computer sciences	Biological sciences	Agricultural sciences	Psychology	Social sciences
1987	24.1	42.0	51.0	42.1	37.8	49.7	19.0	22.9
1991	26.4	47.5	45.5	37.5	37.5	59.3	22.8	22.9
1994	25.9	45.7	45.3	37.7	40.2	50.0	25.0	24.9

NOTE: Physical sciences includes earth and atmospheric sciences.

SOURCES: Tabulations by National Science Foundation/SRS; data from National Center for Education Statistics and IPEDS Completions Surveys, 1987–1994. See appendix tables 3-25, 3-26, and 3-27.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Baccalaureate Origins of Black Women Earning Doctorates *(continued)*

Text table 3-13.
Percentage of bachelor's degrees awarded to black men by HBCUs, by field, selected years: 1987–1994

Year	Engineering	Physical sciences	Mathematics	Computer sciences	Biological sciences	Agricultural sciences	Psychology	Social sciences
1987	23.1	36.0	53.4	39.1	36.5	58.0	16.9	24.7
1991	24.2	41.7	43.2	34.3	33.2	60.0	20.6	20.3
1994	23.8	42.5	39.6	32.8	36.0	50.4	23.8	22.8

NOTE: Physical sciences includes earth and atmospheric sciences.

SOURCES: Tabulations by National Science Foundation/SRS; data from National Center for Education Statistics and IPEDS Completions Surveys, 1987–1994. See appendix tables 3-25, 3-26, and 3-27.

Text table 3-14.
Percentage of bachelor's degrees awarded to black women by HBCUs, by field, selected years: 1987–1994

Year	Engineering	Physical sciences	Mathematics	Computer sciences	Biological sciences	Agricultural sciences	Psychology	Social sciences
1987	26.2	48.7	48.7	44.6	38.6	35.1	19.7	24.4
1991	30.9	53.9	47.6	40.4	39.6	58.1	23.5	24.9
1994	30.3	49.0	50.1	42.3	42.0	49.6	25.3	26.5

NOTE: Physical sciences includes earth and atmospheric sciences.

SOURCES: Tabulations by National Science Foundation/SRS; data from National Center for Education Statistics and IPEDS Completions Surveys, 1987–1994. See appendix tables 3-25, 3-26, and 3-27.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Degree Recipients in Science and Engineering From Universities in Puerto Rico

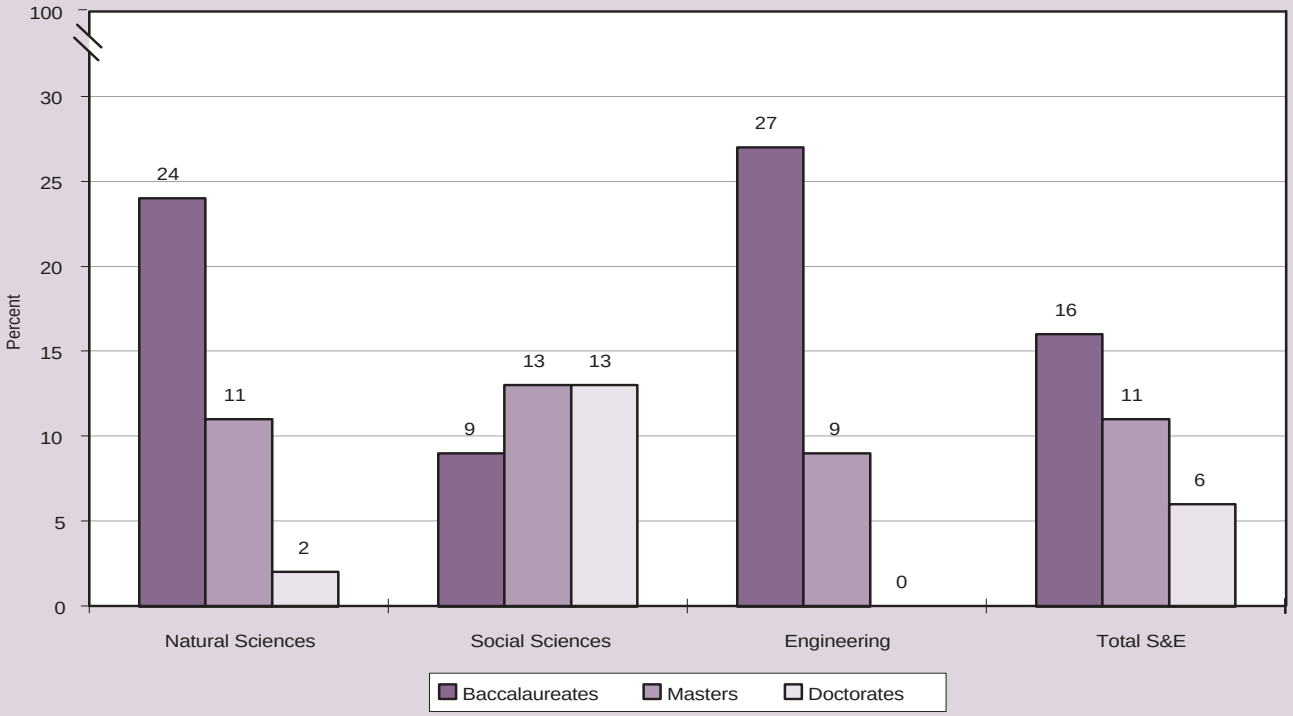
Since 1991, the number of bachelor's, master's, and doctoral degrees in science and engineering (S&E) fields conferred by institutions in Puerto Rico has increased. In 1995, institutions in Puerto Rico accounted for a significant proportion of Hispanics in the United States earning S&E degrees—16 percent of bachelor's, 11 percent of master's, and 6 percent of doctoral degrees (see figure 3-4 and appendix tables 3-28, 3-29, and 3-30).

Universities in Puerto Rico accounted for 27 percent of the engineering bachelor's degrees awarded to Hispanics in the United States in 1995. Among natural science fields, Puerto Rican universities accounted for 26 percent of biological science and 39 percent of physical science bachelor's degrees awarded to Hispanics (NSF, 1997).

Of recent science and engineering bachelor's degree recipients from institutions in Puerto Rico, 35 percent attended graduate school. Of those who earned their bachelor's degree from Puerto Rican institutions and then earned a doctorate in science and engineering from 1991 to 1995, 75 percent earned their doctorates from universities on the continent and 25 percent from universities in Puerto Rico. Two universities in Puerto Rico—University of Puerto Rico at Rio Piedras and University of Puerto Rico at Mayaguez—provided doctorate education to the majority of science and engineering doctorate recipients from universities in Puerto Rico.

Degree Recipients in Science and Engineering From Universities in Puerto Rico *(continued)*

Figure 3-4.
Degrees conferred by institutions in Puerto Rico as a percentage of all degrees awarded to Hispanics in the United States



SOURCE: National Science Foundation/SRS. Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1989–1995, tables 22-30.

Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998

Transition to Graduate Education

Analysis of data from the Graduate Record Examination (GRE) General Test shows that there are differences in mean scores among men and women in different racial/ethnic groups (Educational Testing Service, 1996). These findings may reflect differences in enrollment and outcome described elsewhere in this chapter.

According to a report on GRE performance released by the Educational Testing Service in 1996

- Men and women tend to have similar mean scores on the verbal and analytical measures; however, men have higher mean scores on the quantitative measure.
- Mean scores for non-U.S. citizens are higher than those for U.S. citizens on the quantitative measure and lower on the verbal and analytical measures.
- Whites tend to have higher mean scores than all other racial/ethnic groups on the verbal and analytical measures, whereas Asian Americans have higher mean scores on the quantitative measure.
- Mean scores on all measures are lowest for black and Puerto Rican examinees.
- Mean scores on each measure are higher for men than women across all racial/ethnic groups and measures.

Conclusion

The patterns described in this chapter provide evidence that disparity yet exists among racial/ethnic, gender, and disability categories. Although most bachelor's degrees in engineering, physical sciences, computer science, and agricultural sciences are earned by white males, trends suggest movement toward a greater representation of minorities within these fields. In some fields, women now earn half or more than half of all degrees awarded.

In addition to highlighting historical trends in enrollment and outcomes at the undergraduate level, several interesting findings emerged from the indices of representation. The proportion of white males

and females enrolled as undergraduates has declined since 1980, whereas racial/ethnic minorities have improved their representation in all undergraduate fields, including science, mathematics, and engineering. The rate of improvement among black males has been slower than that of all other minority groups. During the decade of the 1980s, the total number of bachelor's degrees awarded to all underrepresented minorities increased, including degrees in science and engineering.

Data on enrollment and outcomes for students with disabilities is insufficient for detailed analysis. One recent study (Seymour and Hunter, 1998) examines factors that may discourage students with disabilities from completing undergraduate degrees in science and engineering.

Also noteworthy was the role that Historically Black Colleges and Universities and colleges and universities in Puerto Rico play in educating black women and Hispanic students who go on to earn graduate degrees in the sciences and engineering.

Technical Notes to Chapter 3

Indices of Representation: College Enrollment (pages 43–50)

Indices of representation were computed by dividing the proportion of the category enrolled in college by the proportion of the category in the general population 18 through 24 years of age and then multiplying the results by 100.[9] For example, if white males were 35 percent of the general population 18 through 24 years of age in 1994, and 35 percent of the persons enrolled in 4-year institutions of higher education, the IR for white males would be 100. (See appendix table 3-20.) If a category is represented in the college population in the same proportion as it is represented in the general population, its index score will be 100. The term "parity" is used in this chapter to describe this situation. If a category has a higher proportion in the general population than it has in the college population, its index score will be less than 100. The term "underrepresentation" is used to describe this situation.

On the other hand, if a category has a lower proportion in the general population than it has in the college population, its index score will be greater than 100. The term "overrepresentation" is used to describe this situation. It should be kept in mind that a category may have a high index score, yet constitute a small proportion of the college population. For instance, if Asian females constitute 1.95 percent of the general population 18 through 24 years of age, and 2.71 percent of the persons enrolled in 4-year institutions of higher education, their IR score would be 139. (See appendix tables 3-20.)

Indices of Representation: Bachelor's Degrees Awarded (pages 50–56)

Indices of representation were computed to assess the relative representation of racial/ethnic and gender groups in the awarding of bachelor's degrees in 1994 and 1995. For 1994, the proportions of the racial/ethnic and gender groups among full-time, first-time, first-year students in 1990 were divided into the proportion of the racial/ethnic and gender groups receiving bachelor's degrees, and then multiplied by 100. Similarly, for 1995, the proportions of the racial/ethnic and gender groups among full-time, first-time, first-year students in 1991 were divided into the proportion of the racial/ethnic and gender groups receiving bachelor's degrees, and then multiplied by 100. This index can be interpreted similarly as the IR in college enrollment discussed earlier. It is noted that students take different lengths of time to complete a bachelor's degree program, and some programs, notably engineering, are longer than 4 years, but the IR should indicate patterns of differences among the racial/ethnic and gender groups in earning bachelor's degrees. The data for the development of the IRs excluded nonresident aliens and U.S. citizens and permanent residents for whom their race/ethnicity was unknown.

Students With Disabilities (pages 45–46)

Researchers selected the University of Minnesota for the study because of its strong reputation in science, mathematics, and engineering; a record of enrolling a significant number of students with disabilities; and its well-established Office of Disability Services. Within the University of Minnesota, the Institute of Technology (IT) offers degrees in several engineering disciplines, as well as physics, astronomy, chemistry, geology, mathematics, and computer science. University of Minnesota IT students who had registered with the Disabled Services (DS) office of the university were invited to participate in this confidential study. They included 41 of the 93 full-time undergraduates registered at the IT in fall 1993, and a small (N=19) sample of recent graduates (that is, 1 to 5 years since graduation) who were working in the Twin Cities area.

[9] Population estimates from the U.S. Bureau of the Census were used for the general population data. These data included nonresident aliens, persons excluded from the college enrollment data. This difference will have the effect of reducing the Index of Representation for all of the categories. The Census data were obtained from the following reports: U.S. Bureau of the Census, *Current Population Reports, P25-1092*, "Population Projections of the United States, by Age, Sex, Race, and Hispanic Origin: 1992 to 2050." U.S. Government Printing Office, Washington, DC 1992; U.S. Bureau of the Census, *Current Population Reports, P25-1095*, "U.S. Population Estimates, by Age, Sex, Race, and Hispanic Origin: 1980 to 1991." U.S. Government Printing Office, Washington, DC 1993; U.S. Bureau of the Census, *Current Population Reports, P25, No. 601*, "Projections of the Population of the United States: 1975 to 2050," U.S. Government Printing Office, Washington, DC, 1975.

The total number of participants was 65, of whom 60 were IT undergraduates or graduates, and 5 of whom were undergraduates with disabilities majoring in disciplines other than science, mathematics, and engineering.

The students participated in interviews and focus groups, varying in length from 45 to 90 minutes. Interviews were conducted in the style of a focused conversation.

Like students in both public and private institutions, students who register themselves as having a disability at the University of Minnesota have access through the Office of Disability Services to a system of services. Such services were developed first in compliance with the Federally mandated 504 Regulations (1977), which required postsecondary institutions to make all programs accessible to qualified students with disabilities and provide reasonable accommodations, in accordance with the Americans with Disabilities Act (1990).

American Indians in Higher Education (page 42)

The McAfee (1997) study was ethnographic in nature, it examined the experiences of 43 American Indians enrolled in nine undergraduate institutions in eight western states. Of those, 23 had left school. Of that number, only 22 percent were perceived to have a strong identity with their traditional cultures. By comparison, 50 percent of the 16 who had completed baccalaureate degrees were thought to have strong ties to their American Indian heritage.

References

Adelman, Clifford. 1995. *The New College Course Map and Transcript Files: Changes in Course-Taking and Achievement, 1972–1993* (NCES PE 95-800). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Adelman, Clifford. 1997. Community Colleges: Drop-in Centers No More. *The Washington Post*, April 15, 1997, p. A19.

Adelman, Clifford. 1998. *Women and Men of the Engineering Path: A Model for Analysis of Undergraduate Careers*. Washington, DC: U.S. Department of Education and the National Institute for Science Education.

Arnold, K.D. 1987. Values and vocations: The career aspirations of academically-gifted females in the first five years after high school. (Paper presented at the Annual Meeting of the American Educational Research Association, Washington, DC.)

Astin, H.S.,and L.J. Sax. 1996. Developing Scientific Talent in Undergraduate Women. In Cinda-Sue Davis, Angela B. Ginorio, Carol S. Hollenshead, Barbara B. Lazarus, and Paula M. Rayman (Eds.), *The Equity Equation: Fostering the Advancement of Women in the Sciences, Mathematics and Engineering*. San Francisco, CA: Jossey-Bass Publishers.

Boyer, Paul. 1997. Native American Colleges: Progress and Prospects. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.

Educational Testing Service, Graduate Records Examination Board. 1996. *Sex, Race, Ethnicity, and Performance on the GRE General Test: A Technical Report*. Princeton, NJ: Educational Testing Service.

Hall, R.M., and B. Sandler. 1982. *The classroom climate: A chilly one for women?* Project on the Status and Education of Women. Washington, DC: Association of American Colleges.

Hanson, S.L. 1997. *Lost Talent: Women in the Sciences*. Philadelphia, PA: Temple University Press.

Kimball, M.M. 1989. A new perspective of women's math achievement. *Psychological Bulletin*, 105(2), 198–214.

Leggon, C.B., and W. Pearson, Jr. 1997. The Baccalaureate Origins of African American Women Female Ph.D. Scientists. *Journal of Women and Minorities in Science and Engineering*, 3(4), 213–224.

Manis, J., S. Frazier-Kouassi, C. Hollenshead, and D. Burkham. 1993. *A survey of the graduate experience: Sources of satisfaction and dissatisfaction among graduate students at the University of Michigan*. Ann Arbor, MI: The University of Michigan Center for the Education of Women.

Manis, J.D., N.G. Thomas, B.F. Sloat, and C.S. Davis. 1989. An analysis of factors affecting choices of majors in science, mathematics, and engineering at the University of Michigan (CEW Rep. No. 23). Ann Arbor, Michigan: University of Michigan, Center for Continuing Education of Women.

McAfee, M.E. 1997. From Their Voices: American Indians in Higher Education and the Phenomenon of Stepping Out (A report to the Alfred P. Sloan Foundation) New York, NY: Alfred P. Sloan Foundation.

National Science Foundation. 1994. *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1994* (NSF 94-333). Arlington, VA: National Science Foundation.

National Science Foundation. 1996. *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1996* (NSF 96-311). Arlington, VA: National Science Foundation.

National Science Foundation. 1997. *Science and Engineering Degrees, by Race/Ethnicity of Recipients, 1989–95* (NSF 97-334). Arlington, VA: National Science Foundation.

Oakes, J. 1990. Opportunities, achievement and choice: Women and minority students in science and mathematics. In C.B. Casden (Ed.), *Review of Educational Research* (Vol. 16). pp. 153–222.

Seymour, E., and N.M. Hewitt. 1997. *Talking About Leaving: Why Undergraduates Leave the Sciences*. Boulder, CO: Westview Press.

Seymour, E., and A. Hunter. 1998. *Talking About Disability: The Education and Work Experiences of Graduates and Undergraduates with Disabilities in Science, Mathematics, and Engineering Majors.* Washington, DC: American Association for the Advancement of Science.

Strenta, C., R. Elliott, M. Matier, J. Scott, and R. Adair. 1993. Choosing and leaving science in highly selective institutions: General factors and the question of gender (Report to the Alfred P. Sloan Foundation). New York, NY: Alfred P. Sloan Foundation.

U.S. Bureau of the Census. 1975. Projections of the Population of the United States: 1975 to 2050. *Current Population Reports, P25, No. 601*. Washington, DC: U.S. Government Printing Office.

U.S. Bureau of the Census. 1992. Population Projections of the United States, by Age, Sex, Race, and Hispanic Origin: 1992 to 2050. *Current Population Reports, P25-1092*. Washington, DC: U.S. Government Printing Office.

U.S. Bureau of the Census. 1993. U.S. Population Estimates, by Age, Sex, Race, and Hispanic Origin: 1980 to 1991. *Current Population Reports, P25-1095*. Washington, DC: U.S. Government Printing Office.

U.S. Department of Education, National Center for Education Statistics. 1996. Digest of Education Statistics 1996 (NCES 96-133). Washington, DC: U.S. Department of Education/NCES.

Ware, N.C., and D. Dill. 1986. Persistence in science among mathematically able male and female college students with pre-college plans for a scientific major. (Paper presented at the Annual Meeting of the American Educational Research Association).